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(54) **Pipe lining method**

(57) A pipe is lined, for instance to enable it to continue in use after being broken by installing it in a tube (12) impermeable to gas and liquid and having a spirally-wound lost shutter (13) round it. A settable composition (22) is pumped into the shutter (13) from one end and allowed to set while the tube (12) holds the filled shutter (13) against the inside of the pipe (10). After setting, the projecting parts of the tube (12) and shutter (13) are replaced by clamping rings (23). Fig 2 not shown.

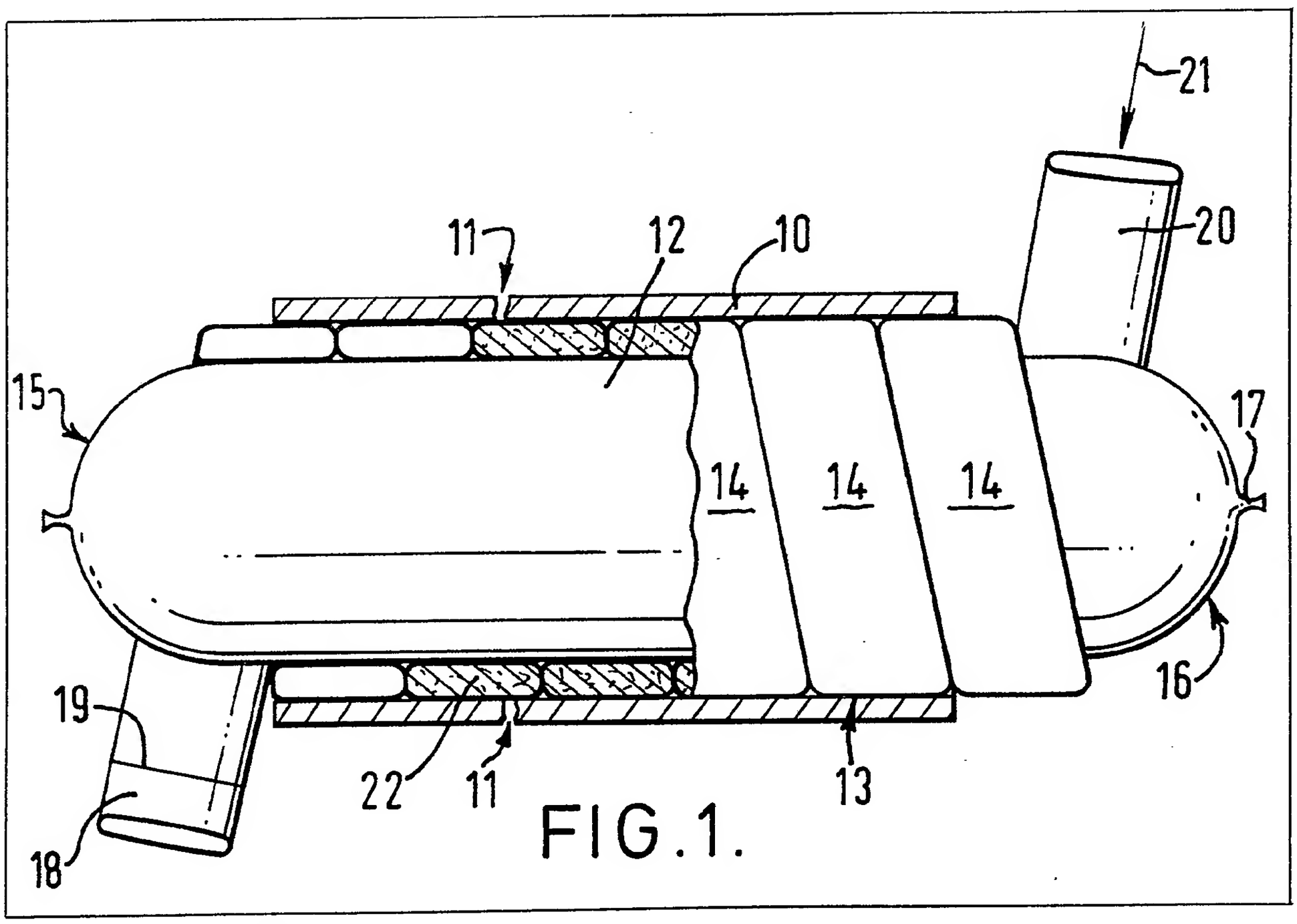

FIG.1.

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The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

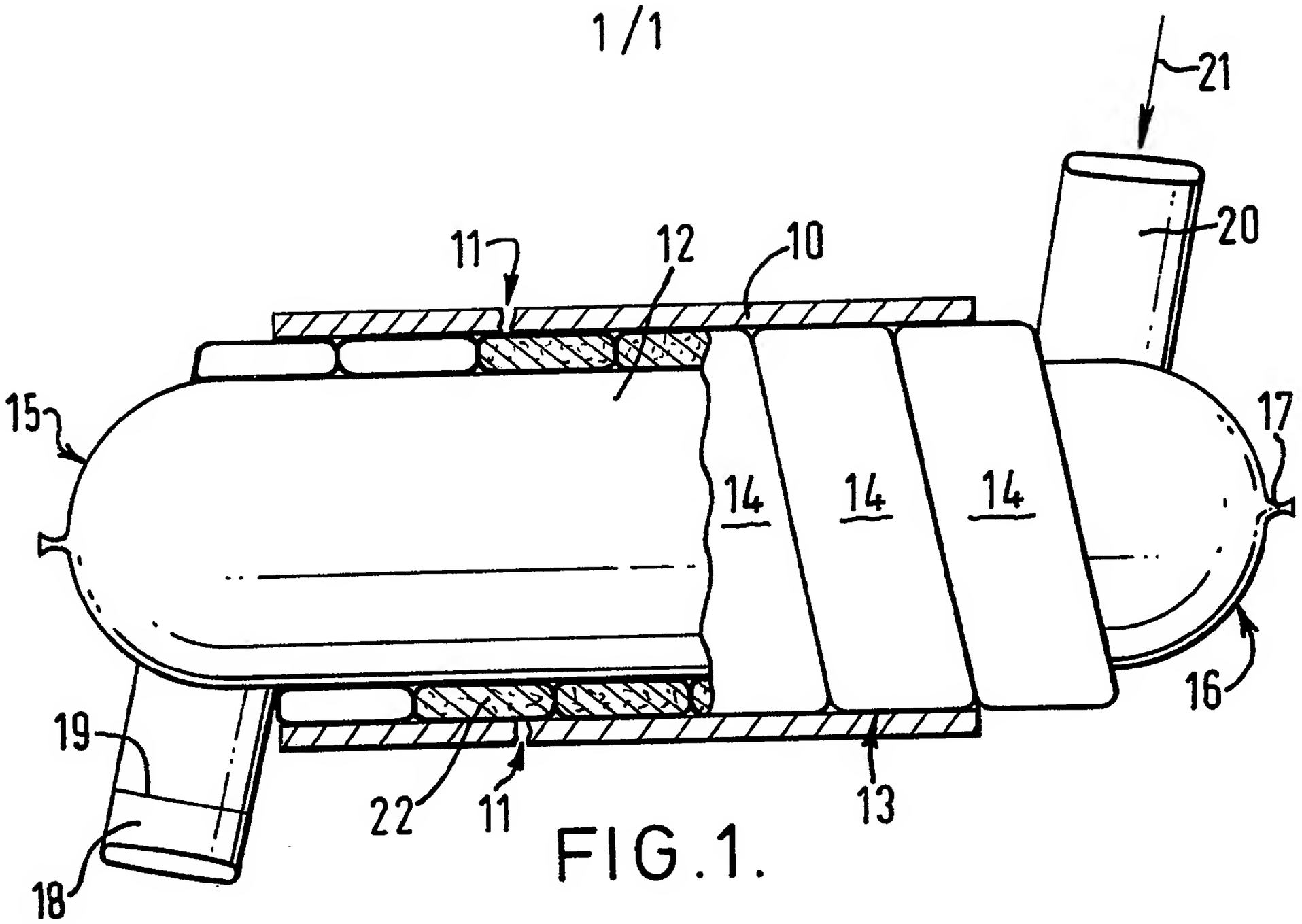
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FIG.1.

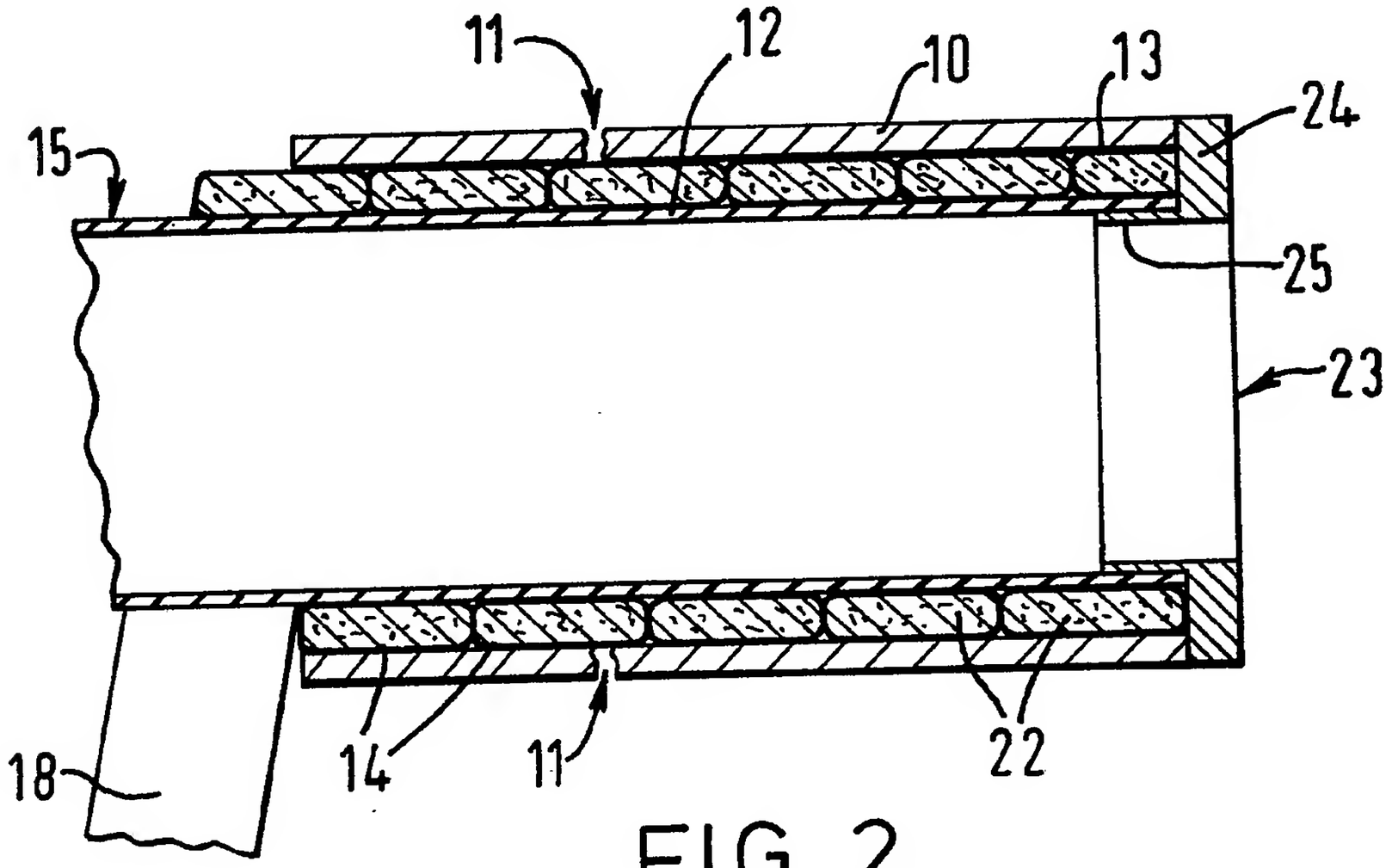
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FIG.2.

SPECIFICATION
Pipe lining method

This invention relates to the lining of pipes, for instance to the provision of a waterproof lining and mechanical support inside a damaged and/or leaking sewer pipe or other underground pipeline. The invention also provides equipment usable in order to carry out the method of lining pipes.

The invention can be carried out in order to prevent leakage from any form of underground pipeline which has been cracked or otherwise damaged or has shifted so as to unseal joints between pipe sections forming the pipeline. In such circumstances, it can be very difficult and time-consuming and may even be impossible to excavate down to the pipeline. The method of the invention makes such excavation work unnecessary and can be used to repair virtually any pipeline where access can be obtained to the pipeline on either and, preferably, both sides of the damaged or otherwise leaking section.

According to one aspect of the invention, a pipe lining comprises a grout-filled lost shutter spirally wound, preferably in contiguous turns, against the inside of the pipe and an expandable tube impermeable to gas and liquid disposed inside and against the spiral lost shutter.

Preferably, the tube comprises a coated reinforced textile structure and, most preferably, each of its ends is clamped to the associated end of the pipe by means of a clamping ring.

According to another aspect of the invention, a method of providing a lining in pipe comprises locating an expandable tube impermeable to gas and liquid inside the pipe over its length, spirally winding a tubular lost shutter around the tube along its length, so that the spirally wound shutter is disposed between the tube and the pipe, expanding the tube to hold the shutter against the inside of the pipe while filling the shutter with a settable composition and maintaining the tube in an expanded condition until the composition sets.

In order that the invention may be readily understood, reference is made to the accompanying drawing, in connection with which a preferred embodiment of the invention, both as to the method of carrying it out and the equipment used and ultimately included in the repaired pipeline, is described below in conjunction with the accompanying drawing. In the drawing:

Fig. 1 shows a side view partly in cross-section of a length of pipeline during installation of the lining in it;

Fig. 2 shows diagrammatically in axial section a view of the completed pipeline with its lining, one end of the lined pipe having been finished, ready for returning the repaired pipeline to service.

Referring to Fig. 1, a pipe 10 constituting part of a pipeline is shown in longitudinal section and this has a crack or other damaged portion in it, indicated generally at 11. In order to return the pipeline to service by repairing the damage represented by the crack 11 and also to provide mechanical support for the damaged parts of the pipe 10, it is necessary to obtain access to at least one and preferably both ends of the pipe 10, that is to say a section of the pipeline on one and, preferably, both sides of the damaged portion. An expandable bladder in the form of a tube 12, preferably of sufficient length to project beyond each end of the pipe 10, is assembled with a lost shutter 13. This comprises a flattened tube which is spirally wound round the bladder or tube 12, preferably after the latter has been closed and inflated to a nominal pressure, so that it assumes a suitable shape. Preferably, the turns of the shutter 13 are welded to the outside of the tube 12. The resultant assembly is then installed in the pipe 10, for instance by being drawn into the pipe 10 by means of a tow-line (not shown) wound on to a winch positioned beyond one end of the pipe 10. When ready to being the operation of *in situ* casting of the pipelining proper, the tube 12 thus projects from either end of the pipe 10 and its complete length within the pipe 10 is surrounded by the contiguous turns of the tube forming the shutter 13. These spirally wound turns 14 of the shutter 13 thus lie against the inside surface of the pipe 10 and are supported in position by the tube 12. Since the tube 12 is inflated and also is impermeable to both gas and liquid, it holds the shutter 13 in place while the casting operation, as described below, takes place. For this purpose, the leading end 15 of the tube 12 is sealed, either while being assembled with the shutter 13 as described above or when the assembly is being installed in the broken pipe 10, and the tube 12 is inflated by means of air or other gas, by way of its trailing end 16, for instance by means of a gas or compressed air connection 17. The tube 12 is preferably constructed of a tubular reinforced textile material which is coated for instance with rubber or a plastics material so as to be impermeable to both gas and liquid. With this combination of properties the lack of permeability to gas enables the tube 12 to be expanded while its lack of permeability to liquids is an essential requirement enabling it to serve as the eventual lining to the pipe 10 so that it can be returned to service. The lost shutter 13 is instead made from a porous woven textile material so that a settable composition, for instance a pumpable concrete mix or a chemcial grout can be pumped along the lost shutter and around its turns 14 so that the entire part of the lost shutter located between the expanded tube 12 and the pipe 10, as shown in Fig. 1, can be filled with the settable composition. For this purpose, the forward end 18 of the lost shutter 13 is sealed as indicated diagrammatically at 19 and the settable composition is pumped into its rearward end 20 as indicated by the arrow 21. As indicated at 22 by the cross-shading, the settable composition progresses from the rearward end 20 to the seal 19 by passing round the respective turns 14 constituting the lost shutter 13. Because the textile fabric constituting the lost shutter 13 is permeable to water, the water displaced from the settable composition 22 can pass out from the turns 14 and the solids in

the composition 22 are retained until the mixture has become compacted and cured by the passage of time. The gas connection 17 can then be removed so that the tube 12 is no longer maintained in a pressurized condition.

In order to complete the repair of the pipe 10, each end of the lining constituted by the tube 12 is then finished off. The part of the tube 12 and the corresponding part of the turns 14 of the lost shutter 13 projecting beyond the right hand end of the pipe 10, as shown in Fig. 2, have been cut off and a clamping ring 23 of L-shaped radial section has then been inserted, the clamping ring 23 including an annular flange portion 24 which abuts the end of the pipe 10 and the end of the tube 12 with the lost shutter 13 sandwiched between them, whilst the clamping ring 23 also includes an internal tubular projection 25 which overlaps the inside surface of the end of the tube 12 and maintains it in sealed contact with the lost shutter 13 with the settable composition 22 therein. The left-hand end of the construction as shown in Fig. 2 is then finished off by the provision of a second clamping ring 23 (not shown) so that the relined pipe section 10 is again ready for service.

CLAIMS

1. A pipe having a lining therein, in which the pipe lining comprises a grout-filled lost shutter spirally wound against the inside of the pipe and an expandable tube, impermeable to gas and liquid, disposed inside and against the shutter.

2. A pipe according to claim 1, in which the shutter is wound in contiguous turns.

3. A pipe according to claim 1 or 2, in which the tube comprises a coated reinforced textile structure.

4. A pipe according to claim 3, in which the tube comprises a textile material coated with rubber or a plastics material.

5. A pipe according to any preceding claim, in which the shutter is attached to the outside of the tube.

6. A pipe according to any preceding claim, in which the shutter comprises porous woven textile material permeable to water.

7. A pipe according to any preceding claim, in which each end of the tube is clamped to the associated end of the pipe by means of a clamping ring.

8. A pipe according to claim 7, in which each clamping ring is of L-shaped radial section having an annular flange abutting the end of the pipe and an internal tubular projection overlapping the inside surface of the tube.

9. A pipe according to claim 1, substantially as described with reference to the accompanying drawing.

10. A method of providing a lining in a pipe, which comprises locating an expandable tube impermeable to gas and liquid inside the pipe over its length, spirally winding a tubular lost shutter around the tube along its length, so that the shutter is disposed between the tube and the pipe, expanding the tube to hold the shutter against the inside of the pipe while filling the shutter with a settable composition and maintaining the tube in an expanded condition until the composition sets.

11. A method according to claim 10, in which the shutter is wound in contiguous turns.

12. A method according to claim 10 or 11, in which the shutter is attached to the outside of the tube.

13. A method according to any of claims 10 to 12, in which the tube is first closed and inflated and then the shutter is spirally wound round it.

14. A method according to claim 13, in which the assembly comprising the tube and the shutter is installed in the pipe by being inserted into one end of the pipe and positioned so as to project from either end.

15. A method according to any of claims 10 to 14, in which the settable composition is pumped along the shutter from one of its ends.

16. A method according to any of claims 10 to 15 in which, after the composition has set, the part of the tube and the shuttter projecting beyond each end of the pipe is removed.

17. A method according to claim 16, in which a clamping ring is provided at each end of the pipe, having an L-shaped radial section comprising a flange which abuts the end of the pipe and an internal tubular projection which maintains the end of the tube in sealed contact with the shutter.

18. A method according to claim 10, substantially as described with reference to the accompanying drawing.

19. A pipe, when lined by a method as defined in any of claims 10 to 18.

20. A broken pipe, when lined and repaired by a method as defined in any of claims 10 to 18.

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